



# UNITED STATES PATENT AND TRADEMARK OFFICE

4bn

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/683,801	10/10/2003	Paul A. Morgan	M122-2411	2171
21567	7590	10/18/2004	EXAMINER	
WELLS ST. JOHN P.S. 601 W. FIRST AVENUE, SUITE 1300 SPOKANE, WA 99201			NGUYEN, HA T	
			ART UNIT	PAPER NUMBER
			2812	

DATE MAILED: 10/18/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/683,801

Applicant(s)

MORGAN, PAUL A.

Examiner

Ha T. Nguyen

Art Unit

2812

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 16 August 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-5, 7-20 and 22-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 20 and 22-26 is/are allowed.
- 6) ☒ Claim(s) 1-5 and 7-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 6-14-4&10-10-3
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

Art Unit: 2812

## **DETAILED ACTION**

### ***Notice to applicant***

1. Applicants' Amendment and Response to the Office Action mailed March 11, 2004 has been entered and made of record. The filing of a Terminal Disclaimer on August 16, 2004 is acknowledged.

### ***Claim Rejections - 35 USC § 112***

2. Claims 1-5 and 7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation "selectively remove the contaminating particles from the surface" in the last two lines. This contradicts with the invention in general, especially claim 20, where the cleaning also removes some silicon oxide from the sidewalls. Besides, the specification neither defines what "selectively" means nor provide a standard for ascertaining the requisite degree of selectivity, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

Claims 2-5 and 7 variously depend from claim 1, they are rejected for the same reason.

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-5 and 7-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Donnelly, Jr. et al., U.S. Patent 6143658 (hereinafter Donnelly) in view of Kwag et al. (USPN 6232228 B1, hereinafter "Kwag").

Referring to Figs. 5A-6E, Donnelly discloses [Re claims 1-3, 8, and 14-15] a method of cleaning a surface of a copper-containing material, comprising; forming a copper-containing

Art Unit: 2812

material 540, 640 over a substrate 520; forming a second material 510, 522 over the copper-containing material; the second material comprising at least two layers stacked atop one another, one of the at least two layers comprising the silicon oxide and the other of the at least two layers comprising the silicon nitride; etching an opening through both of the at least two layers (See fig. 6B and related text) to expose a surface of the copper-containing material at the base of the opening; forming contaminant particles on a surface of the copper containing material, the contaminant particles comprising one or more non-metallic materials selected from the group consisting of copper fluoride inherently formed by the RIE process, copper oxide inherently formed by being exposed to air and silicon oxide; and exposing the surface of the copper-containing material to a cleaning solution formed from hydrofluoric acid (See col. 6, line 6- col. 7, line 25). The examiner interpreted that the cleaning is selective in cleaning contaminant particles. But it does not disclose a semiconductor substrate, the use of HF with nitric acid and hydrochloric acid, and the exposing removing less than 5 Angstroms of the second material from sidewalls of the opening or not changing the configuration of the sidewalls. However, the missing limitations are well known in the art because Kwag discloses the use of an acidic mixture comprising HCl, HNO<sub>3</sub> and HF (see Abstract) and the cleaning of an interconnect structure on a semiconductor substrate (see col. 7, lines 54-64). A person of ordinary skill is motivated to modify Donnelly with Kwag to obtain more effective cleaning. The combined teaching of Kwag and Donnelly is silent about any SiO<sub>x</sub> removed thickness or change in sidewalls configuration. However Donnelly's figures show no change in configuration of sidewalls after the etching. Besides, any variation in removed thickness in the present claims is obvious in light of the cited art, because the changes in removed thickness produce no unexpected function. The routine varying of parameters to produce expected changes are within the ability of one of ordinary skill in the art. Patentability over the prior art will only occur if the parameter variation produces an unexpected result. In re Aller, Lacey and Hall, 105 U.S.P.Q. 233, 235. In re Reese 129 U.S.P.Q. 402, 406.

[Re claims 3-4] Kwag discloses in the case of acidic HNO<sub>3</sub>, HCl, and HF mixture in deionized water, the mixture is an aqueous mixture comprising non-aqueous components, and wherein the non-aqueous components consist essentially of Cl<sup>-</sup>; NO<sub>3</sub><sup>-</sup>, F<sup>-</sup>, at least until the exposing, and the only non-hydroxide anions in the mixture consist essentially of Cl<sup>-</sup>; NO<sub>3</sub><sup>-</sup>, F<sup>-</sup>,

Art Unit: 2812

note that in water the acids produce the anions  $\text{Cl}^-$ ;  $\text{NO}_3^-$ , F and  $\text{H}^+$  ions which form with a corresponding number of water molecule to form  $\text{H}_3\text{O}^+$ , left over  $\text{H}_2\text{O}$  molecules form the balance of the mixture (see abstract and col. 12, lines 7-27);

[Re claim 5] Kwag discloses substantially the limitations of claim 5, as shown above. But it does not disclose expressly the claimed duration of the exposing. However, this would have been obvious in light of Kwag because Kwag discloses that the processing time varies with the amount of material to be removed (see col. 12, lines 33-42);

[Re claim 7] Kwag discloses that the exposing occurs at a temperature of from about 10C to about 40C (see col. 12, lines 23-27).

[Re claims 13 and 16] The combined teaching of Kwag and Donnelly discloses substantially the limitations of claims 13 and 16, as shown above. But Donnelly implies that cleaning removes substantially all of the contaminants including one or more of a copper fluoride and copper oxide (see col. 7, lines 14-23).

[Re claim 17] Kwag discloses that the copper-containing material consists of elemental copper (see col. 11, lines 32-33 and col. 10, lines 54-57).

[Re claims 9, 10, and 18-19] Kwag discloses in the case of acidic  $\text{HNO}_3$ ,  $\text{HCl}$ , and  $\text{HF}$  mixture in deionized water, the mixture is an aqueous mixture comprising non-aqueous components, and wherein the non-aqueous components consist essentially of  $\text{Cl}^-$ ;  $\text{NO}_3^-$ ,  $\text{F}^-$ , at least until the exposing, and the only non-hydroxide anions in the mixture consist essentially of  $\text{Cl}^-$ ;  $\text{NO}_3^-$ ,  $\text{F}^-$ , note that in water the acids dissociate to produce the anions  $\text{Cl}^-$ ;  $\text{NO}_3^-$ , F and  $\text{H}^+$  ions which form with a corresponding number of water molecule to form  $\text{H}_3\text{O}^+$ , left over  $\text{H}_2\text{O}$  molecules form the balance of the mixture (see abstract and col. 12, lines 7-27).

[Re claims 11 and 12] The combined teaching of Kwag and Donnelly discloses substantially the limitations of claims 11-12, as shown above. But it does not disclose expressly the use of a mixture comprising  $\text{HNO}_3$ ,  $\text{HCl}$ , and  $\text{HF}$  with the claimed composition. However, any variation in composition in the present claims is obvious in light of the cited art, because the changes in composition produce no unexpected function. The routine varying of parameters to produce expected changes are within the ability of one of ordinary skill in the art. Patentability over the prior art will only occur if the parameter variation produces an unexpected result. In re Aller, Lacey and Hall, 105 U.S.P.Q. 233, 235. In re Reese 129 U.S.P.Q. 402, 406.

***Allowable Subject Matter***

5. Claims 20 and 22-26 are allowed.

Claim 20 recites "the cleaning removing a thickness of less than 5 angstroms of silicon oxide from the sidewalls without formation of a divot at the interface"

These features in combination with the other elements of the claims are neither disclosed nor suggested by the prior art of record.

Claims 22-26 variously depend from claim 20, they are allowed for the same reason.

***Response to Amendment***

6. In view of Applicants' filing of a Terminal Disclaimer, the Double Patenting rejection has been withdrawn.

In view of Applicants' arguments and the amendment to the claims, the rejections of claims 20 and 22-26 under 35 U.S.C. 103, has been withdrawn.

Applicants' arguments with regard to the rejections under 35 U.S.C. 103 of the remaining claims have been fully considered, but they are not deemed to be persuasive for at least the following reasons.

Applicants argued that the combined teaching of Donnelly and Kwag does not teach removing less than 5 Angstroms of silicon oxide from the sidewalls. It is true that none of the applied reference expressly discloses this feature, however, this would have been obvious, as shown in the rejection, since HF is the acid that etches SiO<sub>x</sub>, the amount of etching depends on the concentration of HF in the cleaning solution. A small concentration of HF would etch a thinner layer of SiO<sub>x</sub> of the sidewalls. The same arguments apply to the etching without changing the configuration of the sidewalls.

***Conclusion***

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

Art Unit: 2812

A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha Nguyen whose telephone number is (571) 272-1678. The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week. The telephone number for Wednesday is (703) 560-0528.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Neibling, can be reached on (571) 272-1679. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.



Ha Nguyen  
Primary Examiner  
10- 15 - 04